

A PROPOSAL TO CONDUCT A STUDY OF  
OVERWINTERING HABITATS OF JUVENILE CHINOOK SALMON  
ALONG THE NORTH CANOL ROAD

10 February 1982

Dr. Valerie L. Hunt  
Chief, Physical Planning Division  
Northern Roads and Airstrips Directorate  
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Department of Indian and Northern Affairs Canada  
Les Terrasses de la Chaudière  
Ottawa, Ontario  
K1A 0H6

by

LGL LIMITED

environmental research associates

Dear Dr. Hunt:

Edmonton, Alberta

I am pleased to submit our proposal entitled:

"A proposal to conduct a study of overwintering habitats of juvenile chinook salmon along the North Canol Road".

The schedule of activities and budget included in our proposal are based on the assumption that a contract will be awarded by 23 February 1982.

If you have any question [regarding our proposal], please contact me.

Prepared for

Sincerely yours,

*John Kristensen*

NORTHERN ROADS AND AIRSTRIPS DIRECTORATE

DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS CANADA

John Kristensen  
Regional Director

Jk/da  
Encl.

February 1982

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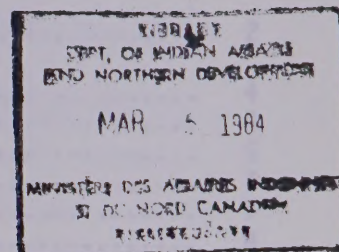


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19 February 1982

Dr. Valerie E. Hume  
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Northern Roads and Airstrips Directorate  
Northern Resources and Economic Planning Branch  
Department of Indian and Northern Affairs Canada  
Les Terrasses de la Chaudière  
OTTAWA, Ontario  
K1A 0H4



Dear Dr. Hume:

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John Kristensen  
Regional Director

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Encl.

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## INTRODUCTION

The Northern Roads and Airstrips Directorate, Department of Indian and Northern Affairs Canada (DINA) is planning to improve access to the Macmillan Pass region, Yukon Territory. Improved access, by way of the North Canol Road, is necessary to permit development of the mineral resources of the Macmillan Pass area.

As part of their initial environmental evaluation of the impacts of upgrading the North Canol Road, DINA co-funded a preliminary fisheries survey which was conducted in the summer of 1981 by Davies and Shepard (1981). Results of that survey indicated that at least six streams crossed by the existing road were inhabited by juvenile chinook salmon (*Oncorhynchus tshawytscha*). On the basis of these results, the Northern Roads and Airstrips Directorate has requested LGL Limited to submit a proposal to conduct a survey and assessment of the potential of numerous streams crossed by the North Canol Road for juvenile chinook salmon overwintering and egg incubation.

More specifically, Terms of Reference issued by the Directorate include the following objectives.

- 1) Identify streams where the construction of culverts and bridges may affect areas critical to winter survival of fish,
- 2) Carry out tests at crossing sites as well as in areas downstream to permit establishment of an adequate buffer zone between construction and overwintering sites,
- 3) Observe and measure ice conditions, open water areas, water depth, water temperature, winter flow rates, dissolved oxygen, and pH,
- 4) Rate each site as to its potential for chinook salmon overwintering and egg incubation, and
- 5) Undertake, where feasible, an inventory of benthic invertebrates.

The study area is to include the right-of-way of the North Canol Road from the vicinity of Ross River, to the end of the road approximately at the Yukon/NWT border.



## BACKGROUND

Most of the fisheries information available for streams crossed by the North Canol Road was collected by Davies and Shepard (1981). Primary objectives of their survey were "to determine fish species composition and distribution; to examine stream utilization by various life stages of fish for spawning, rearing or migration; to evaluate existing road crossing structures in terms of their effect on fish movement and stream habitat; and to identify areas where additional studies may be required to complete a timetable for instream construction". Results of the preliminary survey are summarized below.

Thirty-seven road crossings were examined from the ground and 15 watershed systems between Caribou Creek and the Yukon/NWT border were surveyed from a helicopter. The following fish species were captured: chinook salmon, Arctic grayling (*Thymallus arcticus*), northern pike (*Esox lucius*), burbot (*Lota lota*) and slimy sculpin (*Cottus cognatus*). Of these, the two species of primary significance were chinook salmon, an important commercial and sport species, and Arctic grayling, a popular sport species.

Juvenile chinook salmon were captured in streams at six of the 37 road crossings: Tenas Creek, Blue Creek, Pup Creek, Twin Creek #1, Riddell Creek, and Boulder Creek. The furthest upstream site at which chinook salmon were captured was Boulder Creek. In addition, the authors suspected the presence of juvenile chinook salmon in Tay Creek, based on its size, and further speculated that chinook salmon may be found rearing in most of the Ross and South Macmillan river tributaries that cross the North Canol Road. Streams along the North Canol Road likely are used by chinook salmon for rearing only, although some spawning may occur in some of the larger streams. Spawning occurs in the mainstem of the Ross and South Macmillan rivers (and larger tributary streams) in July, August and possibly September. Eggs hatch the following spring and, following emergence, the fry may spend up to two years in rearing areas. Following this two-year stay in the fresh water, fry (smolt) migrate downstream and out to sea.

Arctic grayling were captured in 20 of the streams sampled and were suspected of inhabiting one additional stream. The furthest upstream site



at which this species was captured by Davies and Shepard (1981) was Dewhurst Creek. Fisheries biologists working for Pan Ocean Oil Ltd. in 1981 captured Arctic grayling in streams a short distance upstream of the Dewhurst Creek crossing (William Stephen, Environmental Coordinator, Pan Ocean Oil Ltd., pers. comm., February 1982).

Northern pike and burbot were each captured in three of the streams sampled by Davies and Shepard (1981), while slimy sculpins were collected from 12 streams. No fish were captured or observed in 15 of the 37 streams at road crossing sites.

## APPROACH

### General

Our approach to conducting a study of overwintering habitats of juvenile chinook salmon is based on the following: the Northern Roads and Airstrips Directorate Terms of Reference, our experience with similar projects, the preliminary fisheries report by Davies and Shepard (1981), and discussions with Dr. Valerie E. Hume, Gordon Maddison, Chris Shepard and Dave Robinson. Precise terms of reference were discussed with Dr. Hume, G. Maddison and D. Robinson; whereas details of the fisheries work conducted along the North Canol Road during summer 1981, streams that should be considered during the proposed study, and problems associated with logistics of the proposed winter survey were discussed with C. Shepard, one of the biologists who conducted the 1981 study.

Because the final report is due by 26 March 1982, we plan to spend only 12 days at the actual study site, and consequently have attempted to identify those streams that must be considered during a winter survey, those streams that should be surveyed, and those streams that are not necessary to survey because they likely will not have sufficient water depths and/or flows in the winter to permit overwintering by juvenile chinook salmon and/or probably freeze to the bottom thereby precluding egg overwintering. Overwintering fish require sufficient water depths to remain in an area (in physical terms) and also sufficient depths, flows and/or open-water areas to ensure adequate dissolved oxygen concentrations. Overwintering eggs do not require deep waters, but do require sufficient oxygenated waters to survive the winter. On the basis of the report by Davies and Shepard (1981) and discussions with Chris Shepard (pers. comm., February 1982) who kindly indicated which streams (other than those where chinook salmon were captured in the summer) should be considered in a winter survey, we tentatively propose to survey the following North Canol Road crossings:

- 1) Tenas Creek, Blue Creek, Pup Creek, Twin Creek #1, Riddell Creek, and Boulder Creek because juvenile chinook salmon were captured in these creeks during summer 1981.



- 2) Marjorie Creek, Tay Creek, Caribou Creek and Jeff Creek because these had relatively high flows during late summer 1981, Davies and Shepard (1981) rated their sport fish potential as moderate-high or high, and Chris Shepard (pers. comm.) felt that these streams might provide overwintering habitat for juvenile chinook salmon (although none was captured in summer 1981).
- 3) If time permits, we propose to also survey Flat Creek, 180 Mile Creek, Flood Creek, Wagon Creek, South Macmillan River #1, Hess Creek, and South Macmillan River #2 because the sport fish potential in these creeks was rated relatively highly and/or late summer flows were relatively high (Davies and Shepard 1981).

In order to confirm the above-established priority of streams to be considered, we will meet with C. Shepard and/or D. Davies in Whitehorse and review the information that they recorded on Point Sample cards. In addition, we will review aerial photos and stream gauge information contained within the document entitled North Canol Road Small Streams Investigation, both of which are available in the Whitehorse Renewable Resources office (G. Maddison, pers. comm., February 1982). Our final choice of crossings to consider will depend, in part, on our review of the above before we commence the field survey. This review will ensure that our time in the field is spent surveying those streams manifesting the highest potential for overwintering chinook salmon and/or eggs.

Immediately following contract award, we plan to fly to Whitehorse, meet with C. Shepard and/or D. Davies, rent a 4 x 4 truck and camper, and travel by road to the study area. A heated camper will permit us to stop along the road wherever we happen to be at nightfall, and will provide an area for our equipment to dry out after each day's use. Depending on air temperatures in the study area it also may be necessary to conduct some of the chemical water analyses in the heated camper. Details of our approach follow.

### Fish

At each of the proposed crossings, we will look for open-water areas both upstream and downstream of the North Canol Road. Tentatively, we

plan to walk, snowshoe or ski approximately 200 m upstream and 400 m downstream of each crossing in search of open water. (A greater downstream distance will be surveyed because potential impacts of road improvement, primarily associated with the construction phase, likely will be greater downstream of the crossing.) When open-water areas are encountered, we will sample for fish with an electroshocker, a small-mesh seine net, and/or hook and line, whichever appears most appropriate (both gas and battery-powered electroshockers will be brought to the field). Shocking, seining and angling will provide direct evidence of fish presence or absence during the late winter. Angling will select for larger fish that might not be captured with either an electroshocker or seine net. Fish catches will be standardized and expressed as nos. of fish shocked/sec. or/m of stream sampled, nos. of fish seined/m of stream sampled or nos. of fish angled/h.

All fish captured will be identified and measured for fork length (mm). Most fish will be released as quickly as possible to avoid injury in cold air temperatures; however, we propose to collect approximately 10 juvenile chinook salmon which will be aged on the basis of otoliths. Although analysis of only 10 fish for age will not provide conclusive information on ages of overwintering salmon, it will provide an index, whereby we may estimate the ages of all other salmon we capture on the basis of fork length. Such information will be useful in determining whether 0<sup>+</sup>-year-olds, 1<sup>+</sup>-year-olds, or both utilize tributaries of the Ross and South Macmillan rivers for overwintering. This procedure will require only a few hours in the laboratory and will not add appreciably to the overall budget.

Although the best information on the presence or absence of fish will be obtained from open-water sampling, we also propose to scan under-ice waters with a periscope at crossings where there are no open-water areas. LGL biologists have successfully utilized this technique in previous winter studies; it simply involves drilling a hole through the ice and scanning the under-ice waters for fish with an inverted periscope constructed of PVC and equipped with a light. Due to the disturbance generated from drilling a hole, observations will be conducted at least one hour after



a hole is drilled. Under-ice observations will be made only in areas where suitable water depths are encountered.

### Overwintering Eggs

Female chinook salmon dig very large redds or nests in which eggs and sperm are deposited simultaneously. After spawning, females cover the eggs with gravel. Chinook salmon eggs are large (6-7 mm in diameter) (Scott and Crossman 1973).

It is not known whether chinook salmon spawn in streams crossed by the North Canal Road, or whether these waters only provide rearing habitat for juvenile salmon that have dispersed from natal areas. We propose to survey open-water areas near road crossings for overwintering eggs. Due to temporal limitations, we will not be able to conduct a quantitative sampling program for eggs using sophisticated sampling gear (e.g., as described by McNeil [1962]); rather, we plan to dig and kick gravel substrate in open-water areas that appear to offer suitable spawning habitat. We will search for large gravel substrates and evidence of gravel-covered redds. Eggs that are uncovered will be counted and identified to confirm that they are chinook salmon eggs. Unless open-water areas along the road have been utilized by significant numbers of spawning salmon, we do not expect to obtain direct information on the presence of eggs--i.e., we consider it fortuitous to uncover overwintering eggs unless there are many redds in the streams. We will not search for eggs in other than open-water areas.

### Benthic Invertebrates

One aspect of assessing the fisheries potential of a stream involves considering food sources for fish. Young chinook salmon in fresh water feed on a variety of invertebrates. We propose to collect benthic invertebrate samples at a maximum of two open-water sites at each crossing--one upstream and one downstream site. (Due to time restraints, we will not sample for benthic invertebrates in under-ice waters, nor will we analyse the collected samples quantitatively.) One sample will be collected with a Surber sampler from each open-water site and preserved in a whirl-pak.

Samples then will be analysed qualitatively back in the truck camper at the end of each field day. This procedure will permit both field biologists to spend most of their time back in the office analysing collected data and preparing a final report. Invertebrates will be identified to broad taxa (primarily Order) and the relative abundance and volume of macroinvertebrate taxa will be determined subjectively. Samples will be brought back to the laboratory and saved, should anyone be interested in analysing these samples quantitatively at a later date.

### Overwintering Habitat and Fish Potential

In addition to sampling in open-water areas for juvenile chinook salmon, overwintering eggs and benthic macroinvertebrates, we will collect information at each crossing surveyed on physical and chemical parameters that will permit us to assess the potential of these areas for fish and/or for egg overwintering. The parameters listed in Table 1, all of which are important to fish and/or egg overwintering, will be assessed/measured at a minimum of six sites (four downstream and two upstream) at each crossing that we propose to survey. Measurements will be relatively easy to make in open-water areas, whereas holes must be drilled in ice-covered areas. Dissolved oxygen, pH and turbidity measurements will be made in waters under ice cover several minutes following disturbance caused by drilling activities to permit conditions to return to normal. Parameters will be measured in the water under the ice surface, not in the drill holes--anomalous conditions may exist in the latter. Numerous photographs will be taken at each crossing surveyed to document visually conditions discussed in the final report.

Information collected on physical and chemical characteristics of the aquatic habitat at each crossing surveyed, combined with information on overwintering juvenile chinook salmon, eggs and/or benthic macroinvertebrates, will serve as a basis for a final and overall assessment of the overwintering fish and egg potential of crossings surveyed. Surveyed crossings will be ranked as to their overwintering potential. Point sample information collected during summer 1981 by Davies and Shepard (1981) also will be considered during our assessment, because several physical



TABLE 1. Physical and Chemical Parameters to be Assessed/Measured at Proposed Stream Crossings along the North Canal Road.

Parameter	Method	Units
Ice thickness	Ice caliper	cm
Open water areas	Subjective estimate of area	m <sup>2</sup>
Snow depth on ice	Meter stick	cm
Water depth	Meter stick or weighted line	cm
Point water velocity	Pygmy current meter	cm/s
Water temperature	Mercury thermometer	°C
Dissolved oxygen	Dissolved oxygen meter or Hach dissolved oxygen kit	mg/L
pH	pH meter	pH unit
Turbidity	Hach turbidimeter	NTU

parameters (e.g., substrate composition) were assessed during their study, but will be difficult for us to assess during the proposed study (except in open-water areas).

### Reporting

All material in the final report will be prepared and organized according to accepted scientific standards. Physical, chemical and biological information will be presented by crossing in catalogue format. In addition, information will be summarized in text form and compared with that collected by Davies and Shepard (1981). A map will be included, identifying the locations of all sampling and measurements.

### Miscellaneous

Necessary permits will be obtained immediately following contract award and will be carried by field personnel at all times during the field survey. (We understand that DINA will assist in expediting the issuance of permits.)

Should LGL be awarded the contract to conduct the overwintering study, close liaison will be maintained with Dr. V. Hume and personnel of the Yukon Department of Renewable Resources, in order that maximum benefit is derived from the proposed study.



## LITERATURE CITED

- Davies, D.J. and C.D. Shepard. 1981. Preliminary fisheries report for North Canal Road. Rep. by Ecological Land Survey for Dep. Indian and Northern Affairs; Dep. Regional Economic Expansion; and Dep. Renewable Resources, Gov. of Yukon. 45 p.
- McNeil, W. 1962. A hydraulic sampler for collecting salmon embryos in spawning beds. Univ. Wash. Fish. Res. Institute. Seattle, Wash. Circular No. 128.
- Scott, W.B. and E.J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Bulletin No. 184. 966 p.

## SCHEDULE

TABLE 2. Tentative Schedule of Activities for the Fish Overwintering Study along the North Canal Road.

Task	Tentative Dates (1982)*
Preparation for field trip	23, 24 Feb.
Discussions with Yukon Government personnel in Whitehorse	26 Feb.
Field survey	28 Feb.-11 March
Data analysis and report preparation	14-24 March
Final report submission	26 March

\*Dates assume that the contract will be awarded by Tuesday, 23 February 1982.



## PERSONNEL

We propose to assign the following LGL personnel to the overwintering study.

Brent Guinn will be the Project Biologist in charge of both field and report-writing aspects of the project. He has supervised an evaluation of fish passage through culverts at Orr Creek, tributary to the Burntwood River, Manitoba, and has sampled for fish in the Yukon Territory immediately south of the North Canal Road. Mr. Guinn has conducted fisheries/limnological studies in the Mackenzie Delta, whitefish research in B.C. and the Yukon Territory, walleye enhancement studies in Manitoba and Alberta, and a study of late winter diet of lake trout in a high-altitude reservoir in southern Alberta. He also has participated in the early winter electroshocking of fish in two tributaries of the North Saskatchewan River.

Vance Buchwald will assist Mr. Guinn with both the field and report-writing aspects of the project. He has conducted numerous winter surveys for fish in both streams and lakes in Alberta. In addition, Mr. Buchwald has conducted juvenile sockeye salmon studies on the west coast of B.C., fisheries and limnological research in the Mackenzie Delta, numerous stream surveys in the Alberta foothills, late winter fish survey in two small creeks in Edmonton, and fish movement studies in the Red Deer River. Mr. Buchwald and Mr. Guinn have worked together on several fisheries studies and are both familiar with winter sampling for fish.

John Kristensen, Regional Director, will supervise the proposed study and will be involved with program design and project administration. He has winter fisheries experience in electroshocking, setting gillnets, fyke nets, and traps in both streams and lakes. Mr. Kristensen has conducted field studies for the last seven years in the N.W.T., B.C., Alberta and Alaska concerning fish movement in relation to obstructions, impacts of various developments on aquatic systems, and fisheries enhancement and limnology; in addition to designing and supervising numerous other aquatic studies.

Dr. Peter Craig, one of LGL's senior fisheries biologists, will review the final report. He has designed, conducted and supervised many fisheries studies in northern Canada and Alaska, numerous of which have been conducted

in the Yukon Territory. Dr. Craig conducted a very similar study to that proposed, which involved surveying many stream crossings along the Shaskwak Highway in the Yukon Territory and northern B.C. He has a breadth of experience concerning winter aquatic studies, and has just completed a study of the Liard River system which involved consideration of fish overwintering potential.

Detailed resumes are appended.



## BUDGET\*

PersonnelField (including preparation and travel to and from study area)

B. Guinn	19 days @ \$224/day	\$ 4,256.
V. Buchwald	19 days @ \$208/day	3,952.
J. Kristensen	1 day @ \$385/day	385.

Office

B. Guinn	10 days @ \$224/day	2,240.
V. Buchwald	9 days @ \$208/day	1,872.
P. Craig	3 days @ \$385/day	1,155.
J. Kristensen	2 days @ \$385/day	770.

Personnel Subtotal	\$14,630.
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Disbursements

Air travel: 2 Edmonton/Whitehorse rtn. @ \$450.	\$ 900.
Freight	700.
Truck and camper rental, and gas	1,600.
Food: 34 man-days @ \$20.	680.
Overnight accommodation in Whitehorse: 2 nights @ \$35.	70.
Equipment rental: 17 days @ \$15.	255.
Expendables	200.
Drafting: 20 h @ \$20.	400.
Communications	200.
Miscellaneous office	350.

Disbursements Subtotal	\$ 5,355.
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TOTAL BUDGET	\$19,985.
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\*This budget does not include any contingency costs associated with poor weather conditions and/or road access problems in the field. Should personnel be unable to work in the field during any portion of the field trip due to one or both of the above, additional costs would amount to \$500/day (personnel plus rental costs).

## RELEVANT PROJECT EXPERIENCE

Fisheries biologists at LGL Limited have conducted many projects that have involved determining overwintering potential for fish in streams, lakes and coastal waters. These studies have included sampling for fish with a variety of gear such as electroshockers, gillnets, fyke nets, minnow traps and hook and line. Several of these studies also have involved describing the overwintering potential for fish on the basis of physical and chemical measurements made in the field. A list of projects conducted by LGL most relevant to the proposed study appears in Table 3.

In addition to those projects listed in Table 3, LGL biologists have conducted and will be conducting in 1982 numerous open-water fisheries studies that involve describing the aquatic habitat and fish potential of streams and rivers on the basis of physical, chemical and biological information collected in the field. Some of these projects include the following:

- 1) An assessment of the fisheries potential of a northern British Columbia sub-alpine stream system and of the potential impacts of a proposed copper/zinc mining operation.
- 2) An assessment of the fisheries potential of a popular sport fishing stream in the central foothills area of Alberta in relation to elemental sulphur dust deposition near and on the stream.
- 3) A biophysical inventory of numerous streams and rivers in the Alberta Oil Sands Environmental Research Program study area. Aquatic habitat characteristics were related to fish utilization, and results were presented in the form of an atlas containing aerial photomosaics, physical and biological data.
- 4) An assessment of the relative quality of sport fish habitat of 12 rivers in the Grande Prairie area to be crossed by an oil pipeline.
- 5) An examination of aquatic habitats along alternative routes proposed for the Nanaimo Bypass Highway.

More detailed information concerning LGL's project experience appears in the accompanying copy of our brochure.

TABLE 3. Fish Overwintering Studies Conducted by LGL Limited.

ent	Area	Time of Year	Purpose	Methods
Oil Ltd.	Wind River, Yukon Territory	March 1981	To determine overwintering areas for fish in the Wind River system	Electroshocking in numerous open-water areas, under-ice periscope, physical and chemical measurements, point sample habitat analysis.
Department of Public Works, Canada and US Department of Transportation	Shakwak Highway, Yukon Territory and British Columbia	April 1978	To determine fish use of streams during winter, and identify preferred seasons for road construction	Under-ice gillnets, baited minnow traps, electroshocking in open-water areas, physical and chemical measurements
British Columbia Hydro and Power Authority	Liard River, British Columbia and Yukon Territory	March 1981	To determine overwintering areas for fish in the Liard River system	Electroshocking in numerous open-water areas, physical and chemical measurements, point sample habitat analysis
Northwest Alaskan Pipeline Company	Gas pipeline route, Alaska	March-April 1979 November 1979 March-April 1980	To determine fish use of water bodies during the ice covered season - presence or absence of overwintering areas	Under-ice gillnets, baited and unbaited minnow traps, baited lines and angling, electroshocking in open-water areas, physical and chemical measurements



BLE 3. Continued.

ient	Area	Time of Year	Purpose	Methods
berta Fish and ldlife Division	Spray Lakes Reservoir and streams, Alberta	March-April 1981	To evaluate the fisheries potential of the Spray Lakes Reservoir and associ- ated inflowing streams	Under-ice gillnets, electro- shocking in open-water areas, physical and chemical measure- ments, point sample habitat analysis
ty of Edmonton	Tributaries of the North Saskatchewan River, Alberta	November 1981	To determine potential impacts to fish of increased stormwater drainage	Electroshocking in open-water areas, point sample habitat analysis
berta Environment	Peace-Athabasca Delta, Alberta	April 1978	To monitor movements of walleye to spawning areas in the Peace-Athabasca Delta	Under-ice gillnets, physical and chemical measurements
tional Oceanic and mospheric Admini- :ration (NOAA)	Nearshore Beaufort Sea-Simpson Lagoon and Prudhoe Bay, Alaska	November 1978 February 1979 May 1979 November 1979 May 1980	To determine fish and epibenthic invertebrate utilization of near- shore waters in the Beaufort Sea during the ice covered season. Presence or absence of overwintering and/or spawning areas for marine fish species	Under-ice fyke nets, gillnets, baited minnow traps, amphipod traps, drop net samples, small hand trawls, periscope obser- vations, line fishing, physical and chemical measure- ments.

ent	Area	Time of Year	Purpose	Methods
ar Gas	Wellington Channel, Northwest Territories	May-June 1976	To determine trophic relationships along a fast ice-edge	Under-ice gillnets, zooplank- ton and phytoplankton sampling, trawling in open water areas at the face of the ice-edge, physical and chemical measurements
ro Canada	Pond Inlet, Northwest Territories	May-June 1979	To determine trophic relationships along a fast ice-edge	Under-ice fyke nets, under- ice Scuba diver sampling, zooplankton and phytoplankton sampling, ice algae studies, physical and chemical measurements

## RESUMES



JOHN KRISTENSEN

Fisheries and Wildlife Biologist; Regional Director

#### EDUCATION

- 1973                    B.Sc. (Honours Zoology), University of Alberta.
- 1973 - 1975           Graduate Studies, Zoology, University of Alberta.

#### PROFESSIONAL EXPERIENCE

- 1981                    Member of LGL Board of Directors. Administrative, supervisory and field research responsibilities including involvement with all Edmonton office projects. Designed, supervised and/or participated in many projects including the following: fisheries and limnological inventory studies; fisheries enhancement studies; and studies to determine impacts of various developments (e.g., pipelines, urbanization, water extraction, water control structures including hydroelectric dams) on lower trophic levels, fish, birds and/or mammals.
- 1980                    Appointed Regional Manager, LGL, Edmonton office. Participated in Prairie Provinces Water Board Ecological Considerations Study which included the study of critical wildlife and fish habitat in five major Alberta river basins. Conducted and supervised study of fish behaviour and movement in the vicinity of two water control structures in the Peace-Athabasca Delta. This study included determining the functional engineering design for suitable fish passage facilities. Participated in field study to assess the impacts of pipeline construction on the water quality and aquatic invertebrates of the Fort Nelson River in northeastern B.C. Conducted a raptor and colonially nesting bird survey in the Cold Lake area, Alberta. Conducted aquatic habitat and fisheries research in northern B.C. to determine potential effects of hydroelectric development on fish resources in the Liard River system.
- 1979                    Conducted and supervised study to document the aquatic fauna and flora of a mountain stream and lake in north-central B.C. Fish, drift and benthic invertebrates, zooplankton, phytoplankton, periphyton, and water quality and sediment parameters were studied. Participated in aquatic habitat mapping study of several streams in the Alberta Oil Sands Environmental Research Program study area. Involved with a simulation modelling workshop on the environmental effects of Alberta oil sands development. Participated in field

JOHN KRISTENSEN

Fisheries and Wildlife Biologist; Regional Director

PROFESSIONAL EXPERIENCE (Cont'd)

- 1979 (cont'd) studies to document use of a salt-water lagoon in the Prudhoe Bay, Alaska area by fish and invertebrates, and to document use of the early summer ice edge at Pond Inlet, N.W.T. by marine phytoplankton, invertebrates, fish, birds and mammals.
- 1978 Conducted research to determine nesting success of western grebes at Cold Lake, Alberta, and conducted waterfowl, raptor, colonial bird, upland game bird and ungulate aerial and ground surveys in the same area. Conducted and supervised research to assess a commercial walleye fishery and to identify spawning locations and determine spawning success of walleye in the Peace-Athabasca Delta, Alberta.
- 1977 Conducted and supervised research to determine onset and duration of spring movement, spawning success, and meristic characters of goldeye in the Peace-Athabasca Delta.
- 1976 Conducted and supervised research on movement of goldeye and other fish species past weirs in the Peace-Athabasca Delta and on the timing and location of goldeye migration from the Delta.
- 1975 Joined LGL Limited. Conducted a literature review of potential impacts of a major roadway on birds and assisted with the analysis of coastal Beaufort Sea bird data. Conducted research on the spawning success and life history of goldeye in the Peace-Athabasca Delta.
- 1973 - 1975 Conducted research on the aggressive interaction among female blue grouse on Vancouver Island, B.C. Teaching assistant, undergraduate biology courses. Courses included the following: Natural history of Alberta vertebrates, Mammalogy, Wildlife management.
- 1971 - 1973 Field research assistant, University of Alberta. Participated in the study of population dynamics of blue grouse on Vancouver Island. Specialized in distraction display behaviour of females.
- 1970 Field assistant, University of Alberta, on paleozoological studies of Cretaceous mammals and dinosaurs near and in Dinosaur Provincial Park, Alberta.

JOHN KRISTENSEN

Fisheries and Wildlife Biologist; Regional Director

PUBLICATIONS AND REPORTS

Several articles in scientific journals concerning bird behaviour and distribution, and fish movement and distribution. Numerous reports concerning freshwater fishes and lower aquatic trophic levels in Alberta and British Columbia. Several reports concerning waterbirds and mammals in Alberta.



JOHN KRISTENSEN

PUBLICATIONS, REPORTS AND ARTICLES

- LGL Limited. 1975. Potential impact of Sarcee Trail (Weasel Head Route A) on avian fauna. Prepared for Reid, Crowther and Partners Ltd. 12 p.
- Kristensen, J., B.S. Ott and A.D. Sekerak. 1976. Walleye and goldeye fisheries investigations in the Peace-Athabasca Delta--1975. Alberta Oil Sands Environmental Research Program Report No. 2, Project AF 4.1.1. 103 p.
- Kristensen, J. 1977. The goldeye - a local anomaly. The Edmonton Naturalist 5(2):28-30.
- Zwicker, F.C., J.A. Redfield and J. Kristensen. 1977. Demography, behaviour, and genetics of a colonizing population of blue grouse. Canadian Journal of Zoology 55(12):1948-1957.
- Kristensen, J. and S.A. Summers. 1978. Fish populations in the Peace-Athabasca Delta and the effects of water control structures on fish movements. Canadian Fisheries and Marine Service Manuscript Report No. 1465. 62 p.
- Kristensen, J. 1979. Walleye studies in the Peace-Athabasca Delta, 1978. Prepared by LGL Ltd. for Fisheries Subcommittee, Peace-Athabasca Delta Monitoring Committee. 54 p.
- Kristensen, J. and W.R. Nordstrom. 1979. Western grebe colony, Cold Lake. Prepared by LGL Ltd. and Prov. Parks Div., Alta. Recreation, Parks and Wildl. for Alta. Recreation, Parks and Wildl. and Esso Resources Canada Ltd. 47 p.
- Kristensen, J. and M.G. Foy. 1980. First record of the round white-fish in Alberta. Canadian Field-Naturalist 94(2):180-182.
- Kristensen, J. 1980. Large flathead chub (*Platygobio gracilis*) from the Peace-Athabasca Delta, Alberta, including a Canadian record. Canadian Field-Naturalist 94(3):342.
- Kristensen, J. 1980. Kutcho Creek project, stage II: environmental baseline studies, fall 1979; surface hydrology, water quality, and aquatic flora and fauna. Prepared by LGL Ltd. for Esso Minerals Canada. 191 p.
- Kristensen, J. 1981. Great blue heron (*Ardea herodias*) colony in the Peace-Athabasca Delta, Alberta. Canadian Field-Naturalist 95(1): 95-96.

JOHN KRISTENSEN

PUBLICATIONS, REPORTS AND ARTICLES (Cont'd)

- Kristensen, J. and S.A. Summers. 1981. Fish populations in the Peace-Athabasca Delta and the effects of water control structures on fish movements: Data. Canadian Fisheries and Marine Service Data Report No. 61. 216 p.
- Andrew, J.H., J.A. Taylor, A.D. Sekerak and J. Kristensen. 1981. Late winter fisheries studies in the Spray Lakes Reservoir watershed, 1981. Prepared by LGL Ltd. for Alberta Fish and Wildlife Division. 94 p.
- Taylor, J.A., J.H. Andrew, J. Kristensen and A.D. Sekerak. 1981. Evaluation of the fisheries potential of the Spray Lakes Reservoir watershed. Prepared by LGL Ltd. for Alberta Fish and Wildlife Division. 66 p.
- Kristensen, J. 1981. Investigations of goldeye and other fish species in the Wood Buffalo National Park section of the Peace-Athabasca Delta, 1977. Canadian Manuscript Report, Fisheries and Aquatic Sciences, No. 1560. 64 p.
- Kristensen, J. 1981. Fishes of the Peace-Athabasca Delta. Alberta Naturalist 11(2):69-76.
- Kristensen, J., J.E. Green and J.A. Taylor. 1981. Potential biological impacts of additional water withdrawals from Ethel Lake, Alberta. Prepared by LGL Ltd. for Water Resources Administration Division, Alberta Environment. 39 p.

BRENT GUINN

Fisheries Biologist

#### EDUCATION

- 1978                    B.Sc. (Honours), University of Manitoba.
- 1982 (expected) M.Sc. (Fisheries Biology), University of Manitoba.

#### PROFESSIONAL EXPERIENCE

- 1982                    Project biologist for the assessment of aquatic resources of a creek and five lakes in western Alberta in the area of a proposed provincial park.
- Project biologist for a study of the impact of elemental sulphur dust produced by a gas plant on surface water quality, benthic stream invertebrates and fish in west-central Alberta.
- Conducted a study into the late winter diet of lake trout in a southwestern Alberta reservoir. This involved identification of fish and invertebrates, a variety of diet analyses and the preparation of a report on the findings.
- 1981                    Joined LGL Limited.
- Project biologist for Lesser Slave Lake-Walleye Enhancement study. Conducted literature review of walleye biology with respect to protection and enhancement of natural spawning and reviewed walleye culturing techniques.
- Conducted LGL research to determine possible effects of hydroelectric development of the Liard River on fishes, invertebrates and phytoplankton in several types of lakes in the Mackenzie Delta. Nutrient budgets and fish production estimates were derived for the various lake types.
- Environment Canada. Supervised three summer students and helped them in identifying benthic invertebrates.
- 1980 - 1981            Laboratory Demonstrator for the following courses at University of Manitoba: Biology of Fishes, Chordate Zoology.



BRENT GUINN

Fisheries Biologist

PROFESSIONAL EXPERIENCE (Cont'd)

1980 Manitoba Dept. of Natural Resources. Supervised evaluation of fish passage through culverts at Orr Creek, tributary to Burntwood River, Manitoba. Fish were captured, marked and recaptured; numerous hydrological measurements were recorded daily; diets of pike were analysed in the field; a creel census was conducted; and population estimates of suckers and pike were derived.

Participated in Walleye Enhancement Program on Lake Winnipegosis with Manitoba Dept. of Natural Resources. Young-of-the-year walleye were captured through use of trap nets, otter trawl nets, and beach seines, and were fin clipped. A commercial walleye catch was examined for fluorescent dye-marked fish.

1978 Joint supervised experimental netting programs in northern British Columbia, Yukon Territory and the N.W.T. Collected lake whitefish from various lakes for electrophoretic analyses. Round and mountain whitefish were collected from lakes and streams for morphological and diet analyses; numerous statistical analyses were conducted of morphological and diet information. Basic distributional information was collected for all other fishes in the area. Plankton samples and basic limnological information were also collected for numerous waterbodies.

Determined effect of Portage la Prairie Diversion Reservoir on plankton populations. Phytoplankton taxa (particularly diatoms) were identified.

BRENT GUINN

PUBLICATIONS

- Guinn, B.R., A.J. Derksen, and B. Parker. 1981. Evaluation of fish passage through culverts at the Orr Creek road crossing on the Thompson-Gillam road, Manitoba. Man. Dept. Natur. Res. (in prep.).
- Guinn, B.R. Character displacement in sympatric populations of mountain whitefish (*Prosopium williamsoni*) and round whitefish (*P. cylindraceum*) in northwestern Canada. M.Sc. (in prep.).
- Smith, S.B. and B. Guinn. 1982. Enhancement of walleye in Lesser Slave Lake, Alberta. Prep. by S.B. Smith Environmental Consultants Ltd. and LGL Ltd. for Fish and Wildl. Div., Alta. Energy and Nat. Res. 60 p.

PETER C. CRAIG

Senior Aquatic Biologist

EDUCATION

- 1967            B.A., (Biology), Stanford University, California.
- 1969            M.A., (Biology), University of California, Santa Barbara.
- 1973            Ph.D., (Biology), University of California, Santa Barbara..

PROFESSIONAL EXPERIENCE

- 1977 to date Senior Aquatic Biologist, LGL Limited, Sidney, British Columbia. Supervisor of aquatic research. Projects include ecological studies of fishes, invertebrates, and water quality in nearshore marine and freshwater habitats in the Beaufort Sea, Alaska.
- 1973 - 1977    Senior Biologist, Aquatic Environments, Ltd., Calgary, Alberta. Position involved original fisheries research, administration, and consulting in aquatic biology.
- 1972 - 1973    Fisheries Biologist, Northern Engineering Services, Calgary, Alberta. Conducted ecological studies of arctic aquatic resources, directed field crews, and assessed environmental impact of a proposed gas pipeline.
- 1970 - 1972    Fisheries Consultant, Alyeska Pipeline Service Company, Bellevue, Washington. Conducted ecological studies of fish and stream invertebrates on Alaska's North Slope and assisted in assessing environmental impact of the Trans Alaska pipeline.
- 1967 - 1970    Teaching Assistant, University of California, Santa Barbara. Courses included General Biology, Zoology, Botany, and Entomology.



PETER C. CRAIG

Senior Aquatic Biologist

SELECTED PROJECT EXPERIENCE

BLM/OCSEAP. A three year on-going field program which examines ecological processes operating in a lagoon-barrier island ecosystem of the Beaufort Sea, with particular emphasis on the role of fishes during winter and open-water seasons.

Prudhoe Bay Waterflood Project. Examination of potential impacts to arctic fish resources resulting from causeways in nearshore environments. Participation in OCSEAP-sponsored workshop and also invited by the Army Corps of Engineers to participate in a subsequent review of potential problems involving fish passage around nearshore causeways.

ABSORB. Reviewed existing fisheries information pertaining to the entire Alaskan Beaufort Sea coastline and prepared sensitivity rankings for fisheries habitats.

Canadian Beaufort Sea. Prepared annotated bibliography of fish resources along the Canadian Beaufort Sea for ESSO Resources, Canada.

Trans Mountain Tanker Route. Inventory of major fish resources along coast of British Columbia and impact assessment of potential oil spills on fisheries.

B.C. Hydro. Project director of major inventory and impact study of proposed hydroelectric developments in the Liard River drainage.

PETER C. CRAIG

Senior Aquatic Biologist

## RESEARCH

Since 1970, research has been conducted in Alaska and northern Canada. This work has involved ecological studies of fish species (e.g., Arctic char, grayling, whitefish, sculpins), invertebrates, and water quality in both freshwater and marine habitats. Fisheries studies include: stream inventories, life histories, toxicity experiments, migrations, temporal and spatial use of streams, lakes and coastal areas. A major research emphasis has been the ecology of salmonids in northern drainages; other investigations have been designed to examine specific industrial problems, e.g., the effects of pipeline construction on streams and fish populations and the effects of offshore development on Beaufort Sea fish and invertebrates. Examples of these studies are listed under Publications and Reports.

Participation in an oceanographic expedition (Stanford University) with research emphasis on the distribution of pelagic coelenterates.

Graduate research involved studies of the ecology and behavior of several species of intertidal invertebrates inhabiting sandy beach (see Publications).

## PUBLICATIONS AND REPORTS

Craig, P.C. 1968. The activity pattern and food habits of the limpet, *Acaea pelta*. Veliger 11 (Supplement): 13-19.

Craig, P.C. 1970. The distribution and behavior of the intertidal sand beetle, *Thinopinus pictus* (Staphylinidae). Ecology 51:1012-1017.

Craig, P.C. 1971. An analysis of the concept of lunar orientation in *Orchestoidea corniculata* (Amphipoda). Animal Behavior 19:368-374.

McCart, P. and P.C. Craig. 1971. A comparison of meristic characteristics of freshwater and anadromous Arctic char, *Salvelinus alpinus*. Journal of the Fisheries Research Board of Canada 28:115-118.

PETER C. CRAIG

Senior Aquatic Biologist

PUBLICATIONS (cont'd) --

Craig, P.C. 1973. Orientation of the sand-beach amphipod, *Orchestoidea corniculata*. *Animal Behavior* 21:699-706.

McCart, P. and P.C. Craig. 1973. Life history of two isolated populations of Arctic char (*Salvelinus alpinus*) in spring-fed tributaries of the Canning River, Alaska. *Journal of the Fisheries Research Board of Canada* 30:1215-1220.

Craig, P.C. 1973. The behavior and distribution of a sand-beach amphipod, *Orchestoidea corniculata*. *Marine Biology* 23:101-109.

Craig, P.C. and P. McCart. 1975. Classification of streams in Beaufort Sea drainages between Prudhoe Bay, Alaska and the Mackenzie River, Northwest Territories. *Arctic and Alpine Research* 7:183-198.

Craig, P.C. and J. Poulin. 1975. Movements and growth of Arctic grayling (*Thymallus arcticus*) and juvenile Arctic char (*Salvelinus alpinus*) in a small arctic stream, Alaska. *Journal of the Fisheries Research Board of Canada* 32:689-697.

Craig, P.C. and P. McCart. 1976. Fish use of nearshore coastal waters in the western arctic: emphasis on anadromous species. Chapter 26, pages 361-388 in Hood and Burrell (editors), *Assessment of the arctic marine environment; selected papers*. Occas. Publ. No. 4, Institute of Marine Science, University of Alaska, Fairbanks.

Craig, P.C. and J. Wells. 1976. Life history notes for a population of slimy sculpin (*Cottus cognatus*) in an Alaskan arctic stream. *Journal of the Fisheries Research Board of Canada* 33:1639-1642.

Craig, P.C., F. Withler, and B. Morley. 1977. Effects of methanol on the fertilization of chum salmon (*Oncorhynchus keta*) ova. *Environmental Pollution*.

Craig, P.C. 1978. Movements of stream-resident and anadromous Arctic char (*Salvelinus alpinus*) in a perennial spring on the Canning River, Alaska.



PETER C. CRAIG

Senior Aquatic Biologist

## REPORTS

McCart, P., P.C. Craig, and H. Bain. 1972. Report on fisheries investigations in the Sagavanirktok River and neighboring drainages. Report to Alyeska Pipeline Service Company, Bellevue, Washington. 150 p.

Craig, P.C. and P. McCart. 1974. Fall spawning and overwintering areas of fish populations along routes of a proposed pipeline between Prudhoe Bay and the Mackenzie Delta. Canadian and Alaskan Arctic Gas Study, Biological Report Series 15(3). 36 p.

Ward, D. and P.C. Craig. 1974. Catalog of lakes, streams, and coastal areas in Alaska along routes of the proposed gas pipeline from Prudhoe Bay, Alaska to the Alaskan-Canadian border. Canadian and Alaskan Arctic Gas Study, Biological Report Series 19. 381 p.

Craig, P.C. and G. Mann. 1974. Life history and distribution of the Arctic cisco (*Coregonus autumnalis*) along the Beaufort Sea coastline in Alaska and the Yukon Territory. Canadian and Alaskan Arctic Gas Study, Biological Report Series 20(4). 32 p.

Craig, P.C. and J. Wells. 1975. Fisheries investigations in the Chandalar River region, northeast Alaska. Canadian and Alaskan Arctic Gas Study, Biological Report Series 34(1). 114 p.

Griffiths, W.B., P.C. Craig, G. Walder, and G. Mann. 1975. Fisheries investigations in a coastal region of the Beaufort Sea (Nunavut Lagoon, Yukon Territory). Canadian and Alaskan Arctic Gas Study, Biological Report Series 34(2). 171 p.

Tape, B. and P.C. Craig. 1975. Reconnaissance of the Alyeska Pipeline: material source borrow methods and an evaluation of these methods with respect to aquatic habitats. Report to Canadian Arctic Gas Study Limited. 28 p.

PETER C. CRAIG

Senior Aquatic Biologist

REPORTS (cont'd)

Craig, P.C. 1976. Arctic char in Sadlerochit Springs, Arctic National Wildlife Range. Presented at the 27th Alaska Science Conference, Fairbanks, Alaska, 6 August 1976. Also in Biological Report Series 41(2) of the Canadian and Alaskan Arctic Gas Study. 30 p.

Griffiths, W.B., J. DenBeste, and P.C. Craig. 1977. Fisheries investigations in a coastal region of the Beaufort Sea (Kaktovik Lagoon, Alaska). Canadian and Alaskan Arctic Gas Study, Biological Report Series 40(2). 180 p.

Craig, P.C. 1977. Ecological studies of anadromous and resident populations of Arctic char in the Canning River drainage and adjacent coastal waters, Alaska. Canadian and Alaskan Arctic Gas, Biological Report Series 41(1). 116 p.

Craig, P.C. 1977. Fisheries research in the Shaviovik drainage with emphasis on Arctic char in the Kavik River, Alaska. Canadian and Alaskan Arctic Gas Study, Biological Report Series 41(3). 28 p.

Childers, R. and P.C. Craig. 1977. A model environmental protection program with an assessment of industrial and government surveillance along the Trans Alaska pipeline. Report to Alaskan Arctic Gas Study Company, Anchorage, Alaska. 120 p.

Craig, P.C. and W.B. Griffiths. 1978. Ecology of fishes in Simpson Lagoon, 1977. Section III in Beaufort Sea Barrier Island-Lagoon Ecological Process Studies, Annual Report by LGL Limited, Environmental Research Associates, to NOAA-OCSEAP, Boulder, Colorado.

PETER C. CRAIG

Senior Aquatic Biologist

REPORTS (cont'd)

Craig, P. and G. Glova. 1977. Catalogue of streams crossed by the Haines Road/Alaska Highway in British Columbia and the Yukon Territory. Rep. by LGL Ltd. for Shawkak Highway Improvement Project, Public Works Canada and U.S. Federal Highway Administration. 75 p.

Craig, P. and G. Glova. 1978. Winter and summer fisheries surveys for the Shawkak Highway Improvement Project, B.C. and the Yukon Territory. Report for Public Works Canada. 65 p.

Chihuly, M., D. Ward, P. Craig, R. McMilland and R. Morrison. 1980. Spring fisheries survey and provisional list of waterbodies along the Alaskan Gas Pipeline route (Prudhoe Bay to the Yukon Territory) proposed by Northwest Alaskan Pipeline Co. Rep. by LGL Ltd. (Alaska) for Northwest Alaskan Pipeline Co. 211 p.

Craig, P., H. McElderry and K. Wiley. 1980. Fish. p. 113-150 and 344-352. In: Vol. 16. In the matter of a pipe line by Trans Mountain Pipe Co. Ltd. for a certificate of public convenience and necessity authorizing the construction and operation of a parallel 762 mm diameter pipeline to accommodate eastward flow of crude oil. Rep. by LGL Ltd. (Sidney) and ESL Environ. Serv. Ltd. for Trans Mountain Pipe Line Co. Ltd. (Vancouver).

Craig, P.C. and W. Griffiths. 1981. Studies of fish and epibenthic invertebrates in coastal waters of the Beaufort Sea. In: Environ. Assess. Alaskan Cont. Shelf, Annu. Rep. Prin. Invest., BLM/NOAA, OCSEAP. Boulder, Colo.

Craig, P.C. 1981. Biophysical and social inventory: fish. p. 19-23 and biological inventory maps: Fish. p. 42-579. In: Alaska Beaufort Sea coastal sensitivity analysis phase 1. Rep. by LGL Ltd. (Sidney) for ABSORB Alaskan Beaufort Sea Oilspill Response Body (Houston).

Craig, P.C. and L. Haldorson. 1981. Beaufort Sea Barrier island-lagoon ecological process studies: Final report Simpson Lagoon. Part 4. Fish. p. 384-678. Res. Unit 467. In: Environ. Assess. Alaskan Cont. Shelf, OCS. Final Rep. Prin. Invest. Vol. 7.



PETER C. CRAIG

Senior Aquatic Biologist

REPORTS (cont'd)

Craig, P.C. and W. Griffiths. 1981. Passage of large fish around a causeway in Prudhoe Bay, Alaska. Arctic 32 (in press).

Craig, P.C. and D. Schmidt. 1982. Fisheries surveys at potential dredging sites at North Slope villages: Wainwright, Point Lay, Atkasook, Nuiqsut and Kaktovik. Rep. by LGL Ltd. (Sidney) for the North Slope Borough.

Craig, P.C., W. Griffiths, L. Haldorson and H. McElderry. 1982. Ecological studies of Arctic cod (*Boreogadus saida*) in Beaufort Sea coastal waters, Alaska. Can. J. Fish. Aquat. Sci. (in press)

Craig, P.C. and K. Bruce. 1982. Fish resources in the Upper Liard River drainage, B.C. In: A.D. Sekerak (ed.). Fish resources and proposed hydroelectric development in the Upper Liard River drainage. Rep. by LGL Ltd. (Sidney) for B.C. Hydro and Power Auth.

Skvorc, P. and P. Craig. 1982. Review of fisheries information for the Chukchi Sea. Rep. by LGL Ltd. (Alaska) for BLM/NOAA, OCSEAP Outer Continental Shelf Environmental Assessment Program.

VANCE BUCHWALD

Fisheries and Wildlife Biologist

#### EDUCATION

1980                    B.Sc. (Animal Biology), University of Calgary.

#### PROFESSIONAL EXPERIENCE

- 1981 - 1982            Conducting the aquatic portions of a master drainage plan study of the Whitemud Creek Basin. Field studies include fish collecting and aquatic habitat assessment. An interim report has been produced with project completion in spring, 1982.
- 1982                    Collected background documents for a workshop on designing a fish monitoring program for the Dickson Dam on the Red Deer River.
- 1981                    Conducted LGL research to determine possible effects of hydroelectric development of the Liard River on fishes, invertebrates and phytoplankton in several types of lakes in the Mackenzie Delta. Nutrient budgets and fish production estimates were derived for the various lake types.
- Conducted fisheries research in the Spray Lakes Reservoir, Alberta, as part of a fisheries enhancement study. Life history information (length, weight, age, breeding condition) was determined for the fish species captured.
- 1980 - 1981            Conducted the field portion of a year-round study of ungulate movements in the Hinton area. The purpose of the study was to identify major movement corridors, so that suitable measures could be taken to minimize the construction of a conveyor belt corridor on ungulate movements.
- Flew wildlife surveys in northeastern British Columbia to determine wildlife populations along two proposed pipeline routes.
- Live-trapped and tagged small mammals on reclamation areas in the Fort McMurray Oil Sands area. This study was conducted to test various methods of reducing small mammal damage to trees in reclaimed areas.
- 1980                    Joined LGL Ltd. Collected sockeye salmon juveniles during night-time trawls from a number of British Columbian coastal lakes. This was part of the Salmonid Enhancement Program to determine if lake fertilization would increase growth and numbers of spawners.

VANCE BUCHWALD

Fisheries and Wildlife Biologist

PROFESSIONAL EXPERIENCE (Cont'd)

- 1980 (cont'd) Identified Grande Prairie fish samples to species, determined their breeding condition, and took basic growth measurements.
- 1979 Alberta Fish and Wildlife Division. Assisted in the planning and carrying out of a stream survey program for portions of the Brazeau River Drainage. Both physical and biological information as it related to the fisheries resource was collected. Also analysed the samples collected and participated in the data analysis.
- 1978 Alberta Fish and Wildlife Division. Assisted Fisheries Habitat protection personnel in the Red Deer region. For the most part this involved assessing the potential impact of proposed pipelines on aquatic habitats. Field inspections, stream surveys, sample identification and data analyses were conducted. Recommendations were made for construction and reclamation techniques.
- 1977 Alberta Fish and Wildlife Division. Assisted in the operation of the Red Cap Sheep project. This involved trapping bighorn sheep and then radio-collaring or tagging them. During the handling of the sheep, various physical measurements were taken and blood, bacterial, viral and fecal samples were collected.
- 1975 - 1976 Alberta Fish and Wildlife Division. Assisted Fisheries Management staff in the Red Deer region. This largely involved working on a number of ongoing fisheries management projects. The main studies were of goldeye movements in the Red Deer River; fish habitat evaluation of parts of Stauffer Creek; evaluating Beaver Creek as a source of water for the Raven Rearing Station; and trapping Dolly Varden in the Clearwater River in order to monitor the spawning population. Also conducted a number of lake surveys and prepared associated reports.
- 1974 Opportunities for Youth. Project Meskunas. Collected information on hiking trails in the Clearwater Forest Reserve of Alberta. This information was collected while backpacking the trails and was presented in a guidebook, along with suggestions on recreational uses of the area.



VANCE BUCHWALD

Fisheries and Wildlife Biologist

REPORTS

Buchwald, V. 1976. Buffalo Lake survey 1976. Rep. for Alberta Fish and Wildlife Division; Alberta Recreation, Parks and Wildlife. 19 p.

Buchwald, V. and J. Kristensen. 1982. Whitemud Creek basin master drainage plan study, aquatic fauna and habitat. Interim report by LGL Ltd. for Hardy Associates (1978) Ltd. 37 p.

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